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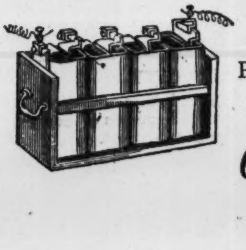

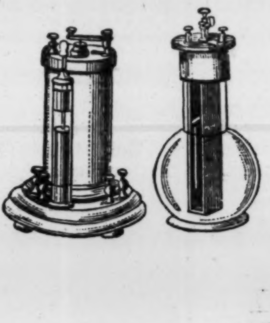

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THE TELEGRAPHIC JOURNAL.

Vol. V.—No. 116.

TELEGRAPHIC COMMUNICATION WITH LIGHTHOUSES.

There can be no doubt, whether regarded from a utilitarian or from a humanitarian point of view, but that the establishment of telegraphic communication between lighthouses and the mainland is a consummation very much to be desired, but whether it can be accomplished is an open question.

The advantage which such means of communication would give to the merchant or ship owner, would unquestionably be very great, and can hardly be exaggerated. It would enable them to issue orders to, or to receive intelligence from, either homeward or outward bound vessels in which they are interested; in fact, the advantages are so manifest, that the non-existence of such means of communication can hardly be laid to the score of indifference to the subject. The establishment of signal stations, in telegraphic communication with the nearest telegraph office at prominent headlands, which are continually passed by vessels, proves that the matter has in one form, received due attention. The abortive attempt, a few years ago, to establish a permanent signal vessel, moored in the English Channel, and in telegraphic communication with the mainland, also shews that such communication is looked upon as highly desirable and likely to be remunerative. Also the proposed laying of a submarine cable to Lundy Island, which has been very frequently suggested and discussed, and which will no doubt be eventually accomplished, may be taken as another proof of the commercial value of the general idea.

Looking at the question from a humanitarian point of view, the desirability of telegraphic communication between lighthouses and the mainland, must be almost obvious. Lighthouses being situated at dangerous and isolated parts of the coast, where wrecks are frequent, are very often the first points of observation from which such occurrences are seen, consequently a timely telegram sent from these to the nearest lifeboat station, would be of the very highest importance, and might be the means of saving many valuable lives, and also of much valuable property.

Whatever form the telegraphic communication takes, it is very necessary that it be reliable, and in working order at the times when it is most required. The recent fatal accident at the Longships' Lighthouse, in which one of the keepers was drowned, was not known till five days after the occurrence, owing to some confusion in working the code signals to shore. The fault here did not lie so much with the means of communication as with the way in which it was worked; but, however that may be, it is certain that a visual system of telegraphy, such as existed at the lighthouse in question, and which can only be worked in a clear atmosphere, is not one which can be relied on, and is almost certain to be useless at the very time it is required to be in full working order. An electric telegraphic system, being the only one which is, in one sense, independent of weather, must be the one adopted if possible; but the question is how can such communication be kept in permanent working order? The advisability of laying a cable to the Eddystone and other lighthouses has been again and again urged, and would be highly desirable, provided it were possible. The mere laying of the cable would present no difficulty whatever, it would be simply an £. s. d. question; but the maintenance in continuous working order of such a cable would be, we venture to say, a problem which no cable engineer would undertake.

The unscientific public, whose fertile brain is never at a loss for some valuable suggestion for effecting such problems as the transportation of Cleopatra's Needle, or selecting a site for the same, finds of course, no difficulty in the matter; but we think that a few weeks or even days spent in a lighthouse situated like the Eddystone or the Bell Rock would, if it firmly convinced any one of the desirability of telegraphic communication with the mainland, would, at the same time, send them away equally convinced of the utter hopelessness of maintaining such communication for any length of time.

Experience has amply shewn that a rocky coast even when sheltered, is not at all the right place for the landing of the shore end of a cable. To make the landing-place of a cable an iron bound coast wholly unsheltered, would be a proceeding which the cable engineer would not entertain for a moment; he would know that however strong be the metal sheathing of the cable, and however well secured the latter be, that the grinding and pounding which it would have to undergo on the first stormy day, would render it useless in a few hours. A worse place for landing a cable than a rock on which a lighthouse is situated, cannot be well conceived, and we fear that the date is very distant when permanent telegraphic communication with isolated lighthouses will be obtained.

As regards signal stations, we are surprised that the use of the telegraph has not been extended to coast guard stations; a large reduction in their number, we should imagine, might be effected if such communication were provided. In many parts of the coast we believe their number is necessarily large, on account of the various headlands preventing one station being seen from another, unless they are close together. We do not know whether the question has been considered, but we should think it is worth consideration.

ON THE EMPLOYMENT OF AN ELECTROMETER WITH A WHEATSTONE'S BRIDGE.

By W. E. AYRTON and JOHN PERRY.

In testing with a Wheatstone's bridge, two points at the same potential have to be experimentally found, one in one circuit, and the other in another circuit. This may be done either with a galvanometer or with an electrometer; but, as a rule, a galvanometer is always employed, since the galvanometric method is usually far more sensitive. There are two cases, however, to which attention have not been specially drawn, in which the employment of an electrometer will lead to far more accurate results than could be obtained by using a galvanometer.

First.—When determining by means of the loop test a *very small* fault in a short piece of cable. Here, since the resistance of the fault is extremely great, many megohms perhaps, but a small current will flow into the cable if the fault be introduced into the battery branch, or if it be introduced into the galvanometer branch then the galvanometer current will be small, even when the adjustments of the resistances are far from those that give balance.

Fig. 1.

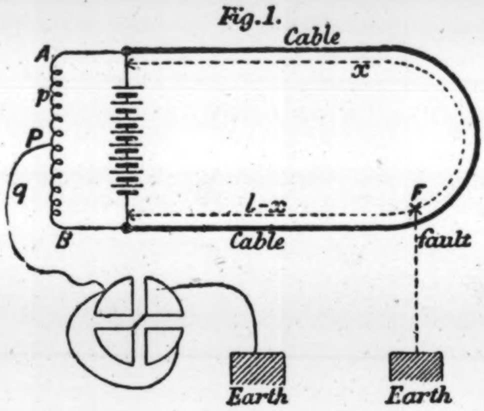


Fig. 2.

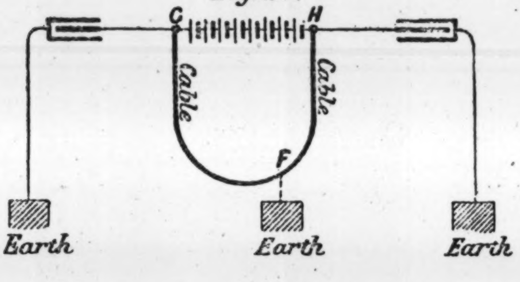


Fig. 3.

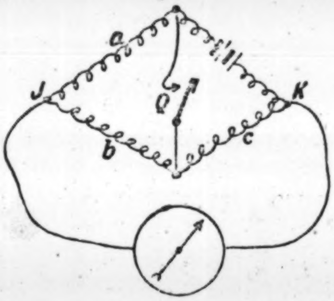
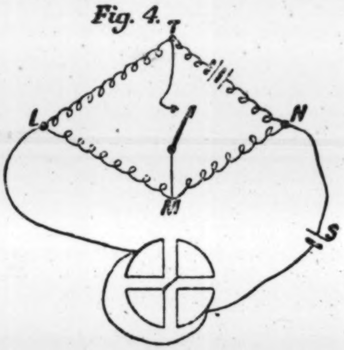


Fig. 4.



But if the connections be made as in the accompanying fig. 1, and by means of an electrometer, a point P be found in the resistance coils A B, having the same potential as the cable tank or the point F in the cable where the fault exists, the delicacy of the test will be practically independent of the resistance of the fault, and, therefore, for *very small* faults will far exceed that obtainable with a galvanometer.

And, again, since the method is a null method, it will give far more accurate results than can be obtained by that of Mr. Latimer Clark, which consists (see Clark and Sabine's electrical tables, page 59) in measuring the potentials at the two points G H, fig. 2, by means of taking discharges of condensers of known capacity, charged by connecting them respectively with the two points G and H, and using the well known equation

$$\frac{\text{resistance of G F}}{\text{resistance of H F}} = \frac{\text{potential of G}}{\text{potential of H}}$$

If there be an electromotive force e in the fault, then this cannot be altered by the method of testing shown in fig. 1, since whether P and F are at the same potential or not, practically no current passes through the fault. To find the position of F when there is an electromotive force in the fault, let p, q be the resistances of the two portions of A B that produce balance when the battery is in the position shown in fig. 1, and let e be equal to the difference of potentials of two points in the coils A B, separated by a resistance z, then

$$\frac{x}{l-x} = \frac{p+z}{q-z}$$

if x is the resistance A F, and l the resistance of the whole loop. When the testing battery is reversed, let $p' q'$ be the resistances of the two portions of A B that produce balance, then

$$\frac{x}{l - x} = \frac{p' - z}{q' + z}$$

$$\therefore\ x = l\,\frac{p + p'}{p + p' + q + q'}$$

Second.—When determining the resistance of a battery, by Mance's test, we have to adjust the resistances a, b, c, fig. 3, until the same current passes through the galvanometer joining J K, whether or not contact is made at Q, that is until the difference of potentials between J and K is the same whether or not contact is made at Q. Mr. Lodge in a paper in the supplementary number of the "Philosophical Magazine," for June 1877, shows fully why the galvanometer method, not being a null method, is an unsensitive one, and he suggests the introduction of a condenser into the galvanometer branch, so that any variation of the difference of potentials between J and K, produced on closing Q, will alter the charge in the condenser, and so produce a transient current in the galvanometer deflecting the needle from zero. But if balance were nearly attained, and if for example the closing of Q only changed the difference of potentials between J and K by the hundredth part of a volt or less, then it would require either a very large condenser or an extremely delicate galvanometer to detect it, whereas if an electrometer and compensating battery S, fig. 4, were employed, and a point M sought for in the circuit L M N, such that making contact between M and T no deflection of the electrometer needle is observed, the arrangement would be extremely sensitive. We would therefore suggest this as an improvement on Mr. Lodge's proposal.

The object of the battery S is to bring all four quadrants at the same potential when M and T are not in contact. As it sends no current, it cannot alter the electromotive force or resistance of the battery under test. As the resistances L M N and L T are not varied, but only the ratio of L M to M N, no adjustment of the battery S or of the electrometer need be made during testing. Of course it is not necessary that S should bring all four quadrants to exactly the same potential, all that is required is that the electrometer needle should be kept permanently near its zero position when contact is not made between L and N so that the electrometer may be adjusted as sensitively as we please.

Instead of a quadrant electrometer a capillary electrometer, with or without the compensating battery S, may be employed, and with such an electrometer one ten-thousandth of a volt (according to Mr. Dewar) can be measured. Now the charge produced by such an electromotive force in any ordinary condenser is immeasurable on any ordinary galvanometer.

In America during the year ending October 1st, 1877, there were 18,629 patents for inventions applied for, and 14,242 issued. The first United States patent was issued in 1790.

ON THE EFFECTS PRODUCED BY ELECTRIC CURRENTS OF HIGH TENSION, AND THEIR ANALOGY WITH NATURAL PHENOMENA.

By M. GASTON PLANTE.

(*Comptes rendus de l'Academie des Sciences*, Vol. LXXXV, p. 619.)

The effects which I described on a former occasion[*] were obtained by causing a powerful electric current to act upon the surface of a saline solution. For the purpose of studying the effects produced upon distilled water, I have augmented the tension of the current employed, by uniting 20 secondary batteries, each composed of 40 couples, making a total of 800 secondary couples, and giving a current about equal to that from 1200 Bunsen's elements.

When this current is caused to act upon distilled water, the effects observed by Mr. Grove with 500 of his nitric acid cells are reproduced, but much intensified. The positive electrode being previously plunged into distilled water, on bringing the negative platinum wire to the surface of the water and immediately removing it, a nearly spherical yellow flame is obtained, about two centimetres in diameter (fig. 1). The platinum wire of two millimetres diameter quickly fuses and remains for some instants in a state of fusion to a height of 14 or 15 millimetres above the surface of the liquid. This flame is formed by incandescent rarefied air, by the vapour of the metal forming the electrode, and by the elements of the decomposed water vapour. Spectrum analysis clearly declares the presence, above all, of hydrogen.

If, to avoid the fusion of the metal the intensity of the current is diminished by interposing a column of water in the circuit, the spark takes the form of a compact little globe of fire, from 8 to 10 mms. diameter (fig. 2). Drawing away, slightly, the electrode, this globe takes an ovoid form; luminous blue points continually varying in number and arranged in consecutive circles, appear on the surface of the water (fig. 3). Rays of the same colour soon start from the centre and join these points (fig. 4). At intervals the rays take up a gyratory motion, tracing out spirals, sometimes in one direction, sometimes in the opposite direction (figs. 5 and 6). Sometimes the points and rays all disappear on one side, and various curves, formed by those which remain, are drawn on the surface of the liquid. Lastly, when the speed of the gyratory motion is increased, all the rays vanish, and only concentric blue rings are seen (fig. 7). The rings are the last phase of these transformations, which, examined either with the naked eye or by means of a lens, are very curious, and may be said to form a real *electric kaleidoscope*.[†]

The production of these figures is explained by the great mobility of the luminous arcs or filaments which compose the ovoid flame formed between the water and the electrode. A careful examination of this form of spark proves that there is, in reality a kind of tassel or *voltaic brush*, analogous to the brushes of static electricity, but more complete by reason of the greater quantity of electricity coming into play. These luminous filaments being in a state of continual agitation, the points where they meet the surface of the liquid are constantly displaced, and form the rays observed. Their gyratory motion arises from the flow of the electric discharge. As to the rings, these are formed, in a manner visible to the eye of the observer, by the motion, more or less rapid, of the blue points, and by the persistance of the impression on the retina.

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[*] *Comptes rendus*, 1876.

[†] These phenomena are comparable with those observed by M. Fernet with induction currents; they also offer a close resemblance to those which result from the falling of liquid drops upon a plane surface and which have been examined by MM. Helmholtz, Thomson, Maxwell, Tait, Rogers, Worthington, Trawbridge, &c.

Fig. 1.

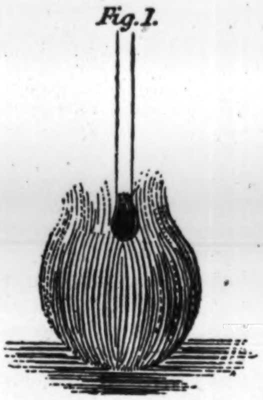


Fig. 2.

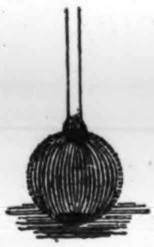


Fig. 3.

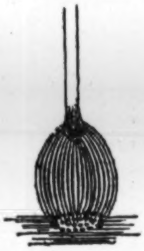


Fig. 4.

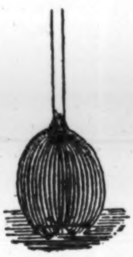


Fig. 5.

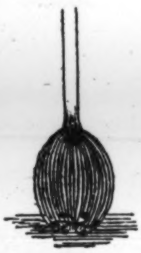


Fig. 6.

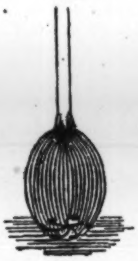
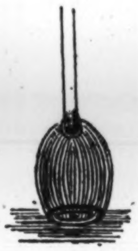


Fig. 7.



When the metallic electrode is positive, and the distilled water negative, the spark still assumes an ovoid form; but the middle is traversed by a core of violet light. When two metallic electrodes are employed, a luminous spheroid is obtained, the interior of which is traversed by a brilliant track. This appearance resembles that of the path and corona of the spark from currents of induction; except that here the corona occupies a proportionally greater space by reason of the greater quantity of electricity. In fact, if the length of the interposed column of water is considerably augmented, nothing but an arc or rectilinear track is obtained.

In these experiments it is not necessary to bring the electrode into actual contact with the water to determine the passage of the electric discharge. The tension of the battery, although the component couples are not very highly insulated, is sufficiently great to cause the spark to occur spontaneously through a distance of about 1 mm. from the surface of the liquid.

This current will also flow through rarefied air; and brilliantly illuminates Geissler tubes if not too much attenuated, producing the stratifications observed under analogous conditions by MM. Gassiot, Warren de la Rue, and H. W. Müller. With a long column of water in circuit it is possible, with a single discharge from the battery, to keep a Geissler tube illuminated for upwards of three hours and a half, owing to the small quantity of electricity expended in passing through the rarefied air.

These experiments form a sequel to those which I have already made known in explaining the mode of formation of the *globular thunderbolt*. They show that with electricity of sufficient quantity and tension, one can obtain, not only electrified liquid globules, but also the electric spark itself in the globular form. This kind of thunderbolt should, therefore, result from the production of an abundant flow of electricity in the dynamic state, in which quantity is joined with high potential. The particular case in which fulminatory globes present slow movements or become stationary, is explained by the motion or repose of the column of moist air, highly electrified and invisible, which serves as an electrode. To imitate this effect it is only necessary in one of the preceding experiments, to cause the electrode, previously suspended in the form of a long pendulum, to vibrate above a vessel filled with water, or a metallic surface, and to hide its lower extremity by means of a screen. A small *ball of fire* is then seen to move along the water or conducting surface, reproducing all the appearances of the natural phenomenon.

LIGHTHOUSE ILLUMINATION BY ELECTRICITY.

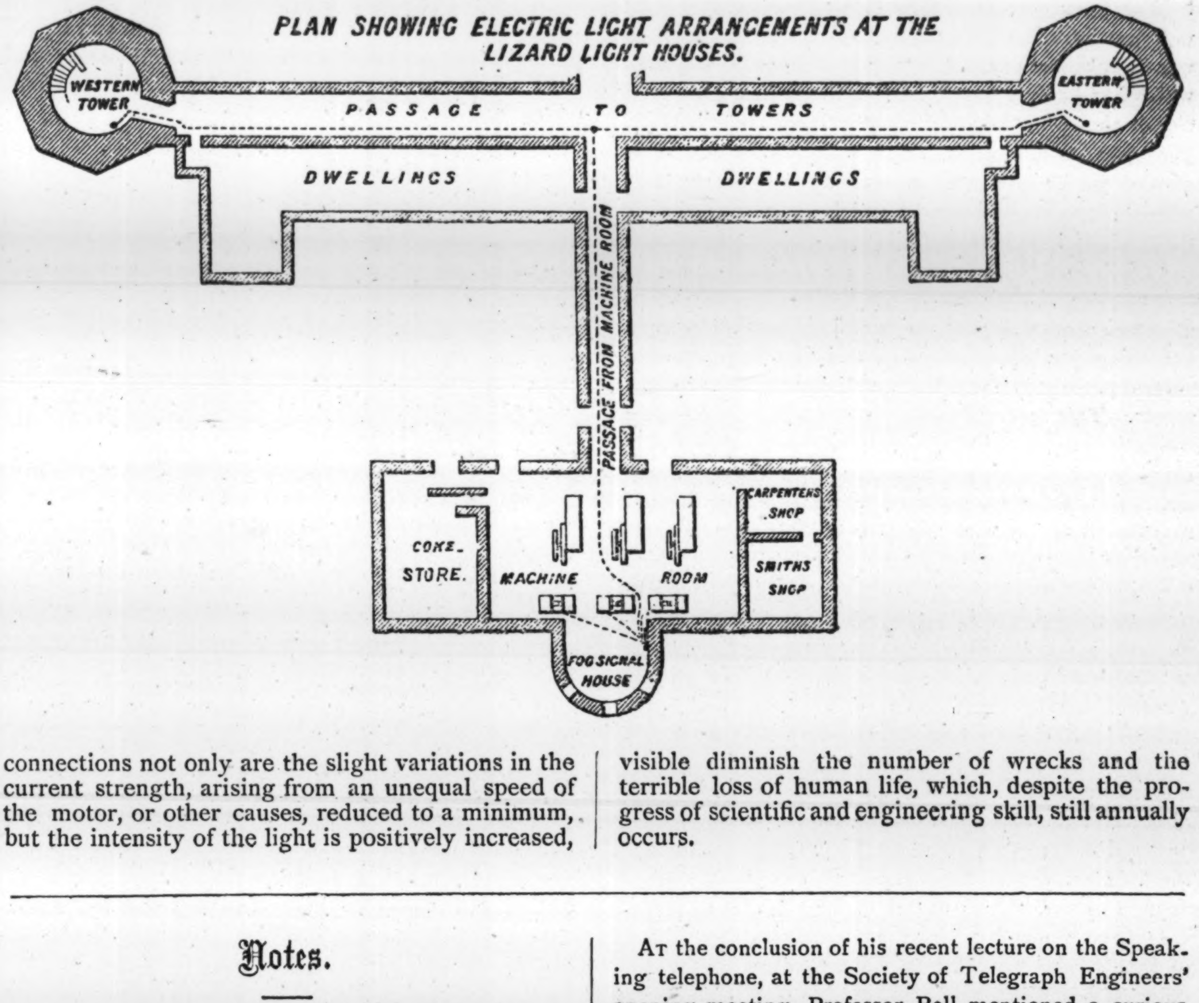
(*Continued from page* 274.)

As it may interest our readers to gain some insight into the general arrangements adopted at the Lizard's, we give here a plan of the lighthouses, showing fog-signal house, engine-room, towers containing the lanterns, &c.

The dynamo-electric machines, six in number, are placed in the engine room and driven direct from belts on the driving wheels of three caloric engines. The dynamo machines are coupled together in pairs, and the leading wires from them to the lamps are led up to a large commutator or current changer, so constructed that the current from any single machine, or any pair of machines can be sent at pleasure into the lamps in the Eastern and Western Towers. In clear weather the commutator is arranged so as to put each lamp in circuit with a single machine, but in misty weather, when a more powerful light is needed, two pair of machines are used, and the currents are, by means of the commutator, sent from the one pair to one lamp and from the other pair to the other lamp.

This joining up of the Dynamo machines in pairs (termed cross-wise connection) is both ingenious and advantageous; it is so effected that the induced currents set up in the armature of machine (A) traverse the coils of and excite the electro-magnets of the second machine (B), thus increasing the intensity of the magnetic field, and inducing more powerful currents in the armature of this machine (B), which currents are carried back to the electro-magnets of the first machine (A) in whose armature still more powerful currents are thereby induced, which again return to machine (B), as above described, and so on until a maximum of intensity is reached.

The two positive terminals of the electro-magnets of the two machines are joined together and brought to one pole of the lamp, and the two negative terminals are also joined together and brought to the other pole of the lamp. By the above method of connections not only are the slight variations in the current strength, arising from an unequal speed of the motor, or other causes, reduced to a minimum, but the intensity of the light is positively increased, or in other words, a more powerful light is obtained with the same horse-power as would be required to work the two machines singly.



PLAN SHOWING ELECTRIC LIGHT ARRANGEMENTS AT THE LIZARD LIGHT HOUSES.

The success of this powerful means of illuminating lighthouses is so complete that we may look forward to the time, not far distant we venture to believe, when the electric light will throw out its powerful beams from every light-tower on our own as well as on foreign coasts, and through its brilliancy and the greater distance from which it is visible diminish the number of wrecks and the terrible loss of human life, which, despite the progress of scientific and engineering skill, still annually occurs.

Notes.

After practically testing the Bell's Speaking Telephone between the Central Telegraph Station and the General Post Office, Berlin, and also through 38 miles of underground cable between Brandenberg and Berlin, the German postal authorities have adopted it into their service. Since November 5, a telephonic circuit has been in regular operation between the room of Herr Stephan, the Postmaster-General, in the General Post Office, and that of the Director of Telegraphs, at the General Telegraph Office, Berlin, thus enabling these gentlemen to converse directly with each other. Further experiments are to be made, and several hundred telephones have been ordered from Messrs. Siemens and Halske.

At the conclusion of his recent lecture on the Speaking telephone, at the Society of Telegraph Engineers' opening meeting, Professor Bell mentioned a curious telephonic phenomena just reported to him from America. It appears that two friends of his in Providence, Rhode Island, were in the habit of conversing with each other by telephone, and on five different evenings they heard to their surprise the music, applause, and speeches of concerts going on. They advertised in the *Providence Journal*, giving the names of songs which were sung and other information, in order to find out the cause of the occurrence, but no such concerts seemed to have been held in Providence. It now appears that the concerts in question were given with the Edison telephone between New York, Albany, Troy, and Sarratoga, but the mode in which the Providence telephones were put in communication with the Edison wire is not at present explained. For instance, it is not known whether or not the Providence wire extends to New York and crosses the line of the Edison wire; but if so, the gentlemen in Providence must have heard the music nearly 200 miles distant from the point where the wires can possibly cross each other.

The Telephone Unmasked.—It is time that the atrocious nature of the telephone should be fully exposed, and its inventors, of whom there are any quantity, held up to execration. When this nefarious instrument was first introduced, it was pretended that its purpose was an innocent one. * * * A series of incidents which has lately occurred in Providence, has, however, clearly shown the frightful capabilities of the telephone. Two men, to whom, so far as is known, no improper motive can be attributed, were recently experimenting with a telephone, the wire of which was stretched over the roofs of innumerable buildings, and was estimated to be fully four miles in length. They relate that on the first evening of their telephonic dissipation, they heard men and women singing songs and eloquent clergymen preaching ponderous sermons, and that they detected several persons in the act of practising on brass instruments. This sort of thing was repeated every evening, while on Sunday morning a perfect deluge of partially conglomerated sermons rolled in upon them. These are the main facts mentioned by the two men in what may be called their official report of their experiments; but it is asserted that they heard other things which they did not venture to openly repeat. The remarks of thousands of midnight cats were borne to their listening ears; the confidential conversations of hundreds of husbands and wives were whispered through the treacherous telephone; and though the remarks of Mr. and Mrs. Smith were sometimes inextricably entangled with those of Mr. and Mrs. Brown, and it was frequently impossible to tell from what particular wife came the direful threat, "O I'll just let you know!" or from what husband in his agony came the cry, "Leggo that hair!" the two astonished telephone experimenters learned enough of the secrets of the leading families of Providence to render it a hazardous matter for any resident of that city to hereafter accept a nomination for any office.—*New York Times.*

Photo-Electricity of Fluorspar.—M. Hankel, at the Saxon Academy of Sciences recently described the results of some experiments he had made on the electric action of light on crystals of fluorspar. After exposure to sunlight, the centre of a face of the crystal is found to have a marked negative potential, while the potential of the sides of the face is much less strong and sometimes positive. On sifting the sunlight through coloured glasses, a layer of water, or a solution of alum or sulphate of quinine, it was found that the chemical rays are the most active. A too strong concentration of light on the face of the crystal destroyed its sensibility to the further action of light. An exposure of the crystal to a temperature of 95° produced the lowest positive potentials at all points of the crystal while it was cooling.

Nature of the Electric Spark in a Gas.—From researches which he has made, M. Cazin concludes that the electric spark in a gas is due to incandescent gas particles, and solid and liquid particles. The gas particles give a bright line spectrum, and the solid and liquid particles a continuous spectrum. They are derived from the gaseous medium and the electrodes. As the pressure of the gas is increased, the solid and liquid particles become more abundant, the continuous spectrum intensifies, and the bright line spectrum seems to dilate, till eventually the two spectra flow into each other, and blend in one continuous spectrum.

The next International Telegraph Conference will meet in London on July 1, 1878.

Recording pulse-beats by telegraph is a feat recently accomplished by Dr. Upham, who, in a lecture lately delivered in Salem, Mass., by telegraphic communication with the Boston City Hospital, exhibited the phenomena in question by throwing a beam of light upon the wall of the lecture room, which vibrated in unison with the exciting cause.—*Philadelphia Polytechnic Review.*

Jablockhoff's Battery.—The positive or oxidisable plate in this novel battery consists of carbon and the liquid which acts upon it, in the same way as acids are employed to act upon zinc in the majority of batteries, is nitrate of potash, nitrate of ammonia, or preferably on account of its cheapness, nitrate of soda. The negative plate is of platinum, or other metal not affected by the molten salt. It may either be immersed in the salt, or made to form the containing vessel of the cell. Whilst the battery is in action, large quantities of gas are given off, similar in their nature to the gases given off by the combustion of gunpowder. These gases, properly collected, may be utilised as a source of motive power. By mixing various other salts in the nitrate employed, the intensity of action of the battery may be regulated, and metallic deposits may be obtained on the platinum or other negative plate.

According to the *Scientific American*, Dr. Rosapelly and Professor Marey have invented a means whereby speech may be graphically reproduced phonetically at the end of a telegraph line. By an ingenious apparatus the movements of the lips, palate, and the vibrations of the larynx are simultaneously inscribed, so that their interaction and succession may at once be seen. The result is a clearly marked phonetic character produced by the voice itself, the sound corresponding to which any one, after a little study, can at once reproduce. The primary purpose of this invention is to teach deaf mutes to articulate, but "it appears quite possible with the apparatus of M. Marey, aided by well known electrical appliances, for the words of a speaker in New York to be taken down in legible shorthand in San Francisco." A detailed account of the contrivance is promised.

By experiments on the length of the electric spark in different gases at the ordinary atmospheric pressures, MM. Warren de la Rue and Hugo W. Müller find that the length of the spark under the ordinary pressure is longest in hydrogen, nitrogen, oxygen, and carbonic acid. It is nearly twice longer in hydrogen than in air. The spark in air between a point (positive) and a plate (negative) with the battery employed (8,040 chloride of silver cells) was about 0·34 inch in length; in hydrogen the length was 0·60 inch. The length of the spark does not appear to depend on the specific gravity of the gas, but rather on its viscosity.

By the use of circular oblique theophones, with a special clockwork for each, M. E. Reguier has succeeded in making an electric lamp which will operate for twenty-four hours. He thinks that the instantaneous obedience of the automatic theophone to its solenoid will enable him to divide a sufficiently intense electric current so as to supply a large number of his lamps.

The Empire of Brazil has asked to be admitted into the International Telegraphic Union, the admission to date from July 1, 1877.

The London School Board entertain the idea of teaching electricity and telegraphy in Board schools. There is no doubt that a knowledge of the Morse code, at least, might be useful in a variety of ways to everybody, but it is something like shorthand, and the School Board have a great many things to teach children before undertaking anything of this kind.

The next advance beyond an articulating telephone is manifestly one which will graphically record speech at a distant place. Among others, Mr. Edison, the famous American electrician, is reported to have achieved this difficult result, at least to a certain extent. He is said to be able to record all but the finer inflections of the voice. His method is at any rate ingenious, and worthy of Mr. Edison. It consists in attaching an exceedingly fine stylus to the vibrating diaphragm of a telephone, and causing a strip of paper to pass under the point by clockwork, so that when the diaphragm vibrates under the action of speech, the point of the stylus will indent the paper along a certain ridge to various degrees. It is said that if this indented paper be at any time drawn under a second telephone, similarly constructed, the indentations are able, by a reciprocal action, to reproduce the speech which gave rise to them. Thus the words of a great orator may be taken down all glowing from his lips, and treasured up, like Morse "slip," to be reproduced at future celebrations in his honour; and in contravention of all past experience, and a great deal of fine poetical thought, we may be enabled to hear "the sound of a voice that is still." Verily science is curtailing in many directions the domain of poetry.

At a recent lecture by Professor Bell on the speaking telephone, Sir William Thomson introduced the lecturer to the audience by the following remarks:—"That evening there was to be brought before them one of the most interesting of the scientific inventions that had been made in this century, or that had ever been made in the history of science—(applause)—the conversion of the quality of speech into motions of electricity, and the reproduction of the effect in audible sound. (Renewed applause.) They might have heard of telephones before that which was now to be brought under their notice. There were telephones before that of Mr. Graham Bell, but those telephones differed from Mr. Bell's in the same sense as a series of claps of the hand differed from the human voice. The previous telephones were in fact electric clappers. (Laughter.) They were instruments in which, by electric action, a succession of shocks, produced by stopping and starting the electric currents suddenly, were produced. Mr. Graham Bell conceived the idea—the wholly original and novel idea—of giving continuity to the shocks, and of producing currents which would be in simple proportion to the motion of the air produced by the voice, and of reproducing that effect at the remote end of the telegraphic wire—reproducing that effect at distances of a few miles, or of scores of miles, with a motion as nearly similar to the motion of the air caused by the voice as that not only was the articulation of the voice heard distinctly, but the different qualities of different voices are heard—(applause)—so that through the telephone, at a distance of 50 miles, one could not only tell what the words were that were being spoken, but they could tell who the person was that was speaking of all the 900,000,000 people living on the earth."

The Society of Telegraph Engineers.—At the annual general meeting, to be held on Wednesday, the 12th of December next, resolutions will be proposed to amend the rules of this society so as to provide for the payment by all those who are nominated and elected into the society on and from 1st January, 1878, of an entrance fee of one guinea for associates and foreign members, and two guineas for members, and to fix the annual subscription payable by such new members and associates at two guineas for associates and foreign members, and three guineas for members, the commutations for life membership being raised in a corresponding manner. Should these resolutions be passed the society will be formed of two classes—old and new. Old members will be those whose names are already enrolled as associates or members, or who may be so enrolled on or before the 31st December, 1877. New members will be those whose nominations bear date subsequent to 31st December, 1877. The payments of those classed as old members will in all cases remain as at present.

IN the Note of our last issue citing M. Planté's explanation of "fire-balls," reference was made to his researches on the luminous arc between a platinum electrode and water. These researches appear in the present number.

MR. HENRY WILDE'S 1863 and 1865 patents for magneto-electric machines have just been renewed, the former for seven, the latter for five years, so that both patents expire in 1884.

THE Paris Academy of Science is about to test practically the advantages of the electric light in mines. These are considered at present to be increased security from explosions due to inflammable gas, and superior illumination. Although the electric light ignites inflammable gas, like an ordinary flame, it does not require fresh air to keep it alight, and can be wholly enclosed in glass, so as to be quite beyond the miners' interference.

AT the recent general meeting of the Eastern Extension Telegraph Company, it was stated that negociations were pending with a view to the duplication of the Banjoewangie to Port Darwin cable, which broke down on November 7, at about 100 miles from Banjoewangie. This duplication would give a security to the Australasian line of communication which is at present very much needed, and would be a great advantage to both the company and the colonists.

THE short section of the Direct United States Cable between Torbay, Nova Scotia, and Rye Beach, New Hampshire, has been repaired by the s.s. "Minia." The transmission of messages is therefore resumed by cable throughout.

THE Western Union Telegraph Company of America had in operation on the first day of July this year 76,955 miles of line, comprising 194,323 miles of wire, and 7,500 offices. This system employs 10,306 sets of instruments for reading by sound, 9 printing instruments, 1,639 recording instruments, 220 repeaters, 183 duplex instruments, 113 quadruplex instruments, 98,558 cells of main batteries, and 21,996 cells of local batteries. The number of messages transmitted during the year ending June 30, 1877, was 21,158,941, being an increase of 2,429,374, or 12·9 per cent. over the year preceding. The average toll upon each message for the year is stated to have been 43·6 cents, the cost of each to the company 29·8 cents, and the profit on each, 13·8 cents.

THE first experiments which have been made with the telephone in Paris took place at the beginning of last month. A lecture was then given before the Société Français de Physique by M. Niaudet.

THE quadruplex instruments continue to work excellently well between London and Liverpool. There can be no doubt now but that the system is a perfect success. Messrs. Gerritt Smith and Hamilton, who have so ably superintended the setting up and working of the apparatus, have returned to America.

City Notes.

Old Broad Street, Nov. 29th, 1877.

IT was *not* explained at the meeting of the Direct United States Cable Company how it happens that the dividend paid to the shareholders is only 5 per cent., when, as has been pointed out in the columns of a daily contemporary, they are entitled to 7½. We did not suppose it would be. But it is a pity that the question was not mentioned. Mr. Pender congratulated the meeting upon the satisfactory results which, in spite of misrepresentations, had crowned the efforts of his colleagues and himself; and Viscount Bury alluded to the enterprise as an "assured moderate success." Yet both Mr. Pender and Lord Bury must know in their own minds that the shareholders of the Direct Company are entitled to a higher dividend than the shareholders of the Anglo-American, and that, therefore, with respect to the matter of dividend, the former have to thank them for—nothing. The speech of Mr. Pender was characteristic. It is evident that the native audacity of that individual has not been impaired by his recent yachting trip. Amongst other things, we learn from him that it never formed any part of his policy to establish high rates for telegraphic messages. The public, however, as Mr. Pender is well aware, regard the three-shilling rate as high, and no company will ever be able to defy competition which does not accept a lower rate. Mr. Pender indignantly repudiated the idea that they were going to "still further raise the rate," and denounced the "misrepresentations" of the wicked persons who said so. That is all very well; but if it be found by-and-bye that the united companies do not make the progress Mr. Pender and his friends anticipated, it is quite probable—his protest notwithstanding—that a four-shilling rate will be announced. It appears that some interrogatories were put to the chairman before the meeting closed, and one of these elicited from that personage the complacent remark that the directors had effected a saving of over £21,000, and "they had avoided a ruinous competition." We should like to have full particulars of the £21,000 before us; they would really be very interesting. But how far "a ruinous competition" has been avoided remains to be seen. We adhere to the opinion we have more than once expressed—that the course pursued by Mr. Pender and his fellow-speculators will ultimately bring about competition, and the competition the amalgamated companies will have to face will be infinitely more formidable than the competition the Direct Company had to contend with when it was on terms of rivalry with the Anglo Company. Mr. Pender knows this; but there are none so blind as those who will not see. The meeting closed, of course, with a vote of thanks to everybody—as the balance-sheet was not discussed we need not refer to it—and Mr. Pender no doubt went home feeling that he had again discharged a painful duty.

There was one question which the chairman of the Direct Company prudently forebore from dwelling upon. No information was given to the meeting as to the course likely to be pursued by the Government of the United States with regard to the concession obtained by the Direct Company under what was, at least, a misapprehension. This is the more surprising, seeing that Mr. Pender might have justified his opinion by that of an American journal, which has manfully taken up the cudgels on behalf of the Company. We learn from that journal that "the authority to impose conditions under which cables connecting foreign countries may be landed on the shores of the United States, if it exists at all, resides solely in Congress, and until Congress sees fit to legislate on the subject, which it has not yet done, there is no power which can lawfully interfere with the continued operation of the cable at Rye Beach." But with all deference to our contemporary, whose statement, at any rate, is in one sense decided enough, we are inclined to think that if the matter was as it is represented to be in the columns of the *Journal of the Telegraph*, Mr. Pender would have long since assured the shareholders of the Direct Company that they had nothing to fear from the American Government. His silence at the recent meeting, with such a piece of knowledge, would have been startling. Besides, our contemporary evidently only guesses as to what Congress can do and what it cannot do, or the words, "if it exists at all," would surely have been left out of an otherwise positive declaration.

There might have been some little unpleasantness at the extraordinary meeting of the Mediterranean Extension Telegraph Company; but the shareholders present gave Sir James Carmichael the "clean bill of health" he asked for, and the report and accounts were adopted. We notice it was asked why there was only one auditor to the company, and the reply was given that the company could not afford a second. Although the meeting afterwards appointed an honorary auditor, we are disposed to think that there might, under any circumstances, be two paid auditors. There is such a thing as being penny wise and pound foolish.

We suppose the member of the board of the Eastern Extension Telegraph Company, who is shortly to be dispatched to Australia, is not the chairman. Important as the duplication of the company's cable may be, Mr. Pender probably feels that his presence in this country is of far greater moment. Otherwise, we should think the mission would suit him, and he would certainly return home a still greater authority on telegraphy. The company has not, it seems, been purchased by the Australian Government, nor is it likely to be, unless the Australian Government make a very tempting offer.

Since our last issue there has been a great deal of discussion respecting the failure of the negotiations between the Sheffield and the Great Northern and Midland Railway Companies; but the interest is now dying out. The statement issued by the directors of the Sheffield Company was, of course, intended for a defence, but it utterly failed in its object. It is all very well for Sir Edward Watkin to assert that the Sheffield dividend will be 4½ per cent. for the current half-year. Probably it may. But to make that probability the ground of holding out for a perpetual dividend, when since 1849 the Company has never declared a dividend of 4 per cent., was manifestly absurd. The directors of the Great Northern and Midland Companies would have lost the confidence of their shareholders at once had they consented to entertain the demand at all.

The directors of the Inner Circle Completion Company have, we believe, obtained the money they required, in spite of what we have stigmatized as unkind opposition on the part of the Metropolitan Board, and, subsequently, hostility from the City editor of the *Times*. In the strictures which have from time to time been passed upon Mr. Crump we do not agree. We are persuaded that the influence of the *Times'* City articles is, on the whole, more potent for good than in days of yore, and we do not doubt that most of the persons who denounce Mr. Crump as ignorant or captious, have been wounded, in some way or other, by his righteous maledictions. But every man, save the Pope, is fallible, and respecting the Inner Circle Completion Company we do fancy Mr. Crump made a mistake. It was from the outset palpable that he did not look upon the scheme with favour, and although Mr. Forbes, in a temperate remonstrance, appeared to us to refute his criticism, he not only did not offer to make amends, but gave the Company another and more cruel stab. That the directors have succeeded in getting what they wanted, is not because investors are not guided by what the *Times* says, but because, for once, the City editor was manifestly worsted in argument.

"The Railway Autocracy: a question of vital importance to shareholders and directors hitherto overlooked," is the title of a somewhat striking pamphlet from the pen of Mr. Edwin Philips, the editor of the *Railway Service Gazette*. We cannot, however, agree with Mr. Philips' main proposition which is, that a railway board can do anything, and we regret that Mr. Bass should have endorsed the theory, cleverly worked out though it be. We may, on another occasion, examine some of the arguments used in support of it.

SELENIUM.

By T. FLETCHER, A.S.T.E.

THE element selenium, owing to its great rarity and consequent costliness, has hitherto been but little known; and, but for the science of telegraphy, it would probably have remained so, more especially as neither it, nor any compound of it, has been employed in the arts. Of late years, however, a considerable amount of interest has attached to selenium in consequence of certain very remarkable characteristics which have been noticed in making experiments with it for electrical purposes. It is thought, therefore, that a slight sketch of these characteristics may not be out of place in these columns.

Selenium (Σελήνη, *the moon*), was discovered by Berzelius, and belongs to the class of elements which, like phosphorous, &c., appear to rank midway between the metals and the non-metals. It is obtained chiefly from Sweden, where it is found in certain pyrites used in the manufacture of sulphuric acid.

Selenium, like phosphorous, is capable of existing in three allotropic states—(1), a red amorphous powder, fusing a little about 100° C.; (2), vitreous, brittle, deep brown, with metallic lustre, tasteless and odourless, a non-conductor of heat and electricity; this form becomes plastic above 100° C., and if heated to a little over 200° C. becomes crystalline and conducting; (3), crystalline rhomboidal prisms, which melt at 217° C. and boil at 700° C., and which can be obtained from the solution in bisulphide of carbon. It is only this latter form which is fit for electrical use. Its specific gravity is about 4·5.

During the laying of the 1866 Atlantic Cable, Mr. Willoughby Smith, who was in charge of the electrical department, devised a method of testing, since well known to electricians, by means of which communication could be carried on between ship and shore at the same time that a continuous insulation test was maintained on the cable. For this purpose it was necessary to use a high resistance between the cable and the testing instruments. Various forms of resistance were employed, such as coils, alternate plates of tinfoil and gelatine, &c., but were not found sufficiently constant to be satisfactory. While casting about for new materials from which to construct a constant resistance, Mr. Smith's attention was called to selenium, which was already known to possess a low conductivity. Several specimens were obtained, in the form of little bars, varying from 5 to 10 centimetres in length, and from 1 to 1·5 millimetre in diameter. Each bar was hermetically sealed in a glass tube to avoid contact with moist or warm air, and connection was made by means of platinum wires fused into the glass tubes. Mr. Smith entrusted the carrying out of the experiments with these samples to his assistant, Mr. May; and we believe we are correct in stating that it was this gentleman who first noticed the erratic behaviour of selenium when exposed to lights of different intensities.

The result of these experiments was first made public in a communication, dated 4th February, 1873, from Mr. Willoughby Smith to the Society of Telegraph Engineers. In this letter it was stated that considerable discrepancies were observed in the measurements of the bars; and that not only did different operators fail to obtain the same results, but that the same operator frequently obtained results which were entirely at variance. "While investigating the cause of such great differences in the resistances of the bars, it was found that the resistance altered materially according to the intensity of light to which they were subjected. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest and remained very constant, fulfilling all the conditions necessary to my requirements; but immediately the cover of the box was removed, the conductivity increased from 15 to 100 per cent., according to the intensity of the light falling on the bar. Merely intercepting the light by passing the hand before an ordinary gas-burner, placed several feet from the bar, increased the resistance from 15 to 20 per cent."

Subsequent experiments, in which coloured glasses were employed, showed that the resistance also varied with lights of different refrangibility.

"To ensure that temperature was in no way affecting the experiments, one of the bars was placed in a trough of water so that there was about an inch of water for the light to pass through, but the results were the same; and when a strong light from the ignition of a narrow band of magnesium was held about 9 inches above the water, the resistance immediately fell more than two-thirds, returning to its normal condition immediately the light was extinguished." Rock-salt, alum solution, &c., were also employed to intercept the heat-rays, and with similar results.

The subject having been thus prominently brought forward, it was naturally taken up by other experimenters; and in a paper read before the Royal Society (*vide* Proceedings, 1873), Lieut. Sale, R.E., described a most interesting series of experiments which had been undertaken with a view to further elucidate the matter. From this paper we cull the following notes:—

In the first place, the experiments of Mr. Willoughby Smith were repeated and verified. The solar spectrum was then employed, and the following results obtained:—

	Ohms.
Resistance in darkness	330,000
„ violet	279,000
„ blue and indigo	279,000
„ green	278,000
„ orange	277,000
„ diffused daylight only ...	270,000
„ red	255,700
„ centre of red	255,000
„ outside edge of red ...	220,000
„ ultra-red	228,000
„ darkness, immediately after exposure (resistance rising)	310,000

These experiments were said to have been so clear in their indications, that a very slight motion of the prism was immediately responded to by the spot of light.

The diffused daylight was then cut off as much as possible by screens, and measurements again made, as follows:—

	Ohms.
Resistance in red	240,000
„ just outside red	240,700
„ in blue	270,000
„ such diffused light as came through screens	290,000
„ darkness (resistance rising)	310.000

The spectrum of the electric light was also tried, but the results were more feeble; the maximum effect was obtained in, or just at the edge of the red, the violet and blue rays producing scarcely any effect.

The general results of these experiments were summed up by Lieut. Sale as follows:—

(1) That the resistance of selenium is largely affected by exposure to light.

(2) That this effect is not produced by the actinic rays, but is at a maximum at, or just outside the red rays, at a place nearly coincident with the locus of the maximum of the heat-rays.

(3) That the effect of varying resistances is certainly not due to any change of temperature in the bar of selenium.

(4) That the effect produced on exposure to light is sensibly instantaneous, but that, on cutting off the light, the return to the normal resistance is not so rapid.

"It would seem that there exists a power in rays nearly coincident with the heat-rays of high intensity, of altering instantaneously and without change of temperature, the molecular condition of this particular element."

Subsequent experiments have been from time to time made, though in a somewhat desultory manner, by Lord Rosse, Professor W. G. Adams, and others, in which tellurium has been compared with selenium (*vide* Proceedings of the Royal Society, Vols. xxi., xxii., xxiii.). In one of Lord Rosse's experiments (Phil. Mag., Vol. xlvii., No. 311), a lighted candle, placed 3½ inches from a bar of selenium, produced a fall of 24·3 per cent. in the resistance. A vessel of hot water was then placed near the bar, but without producing any effect. Various intercepting films were interposed between the bar and the source of light or heat, and still the results were perfectly consistent with those previously obtained.

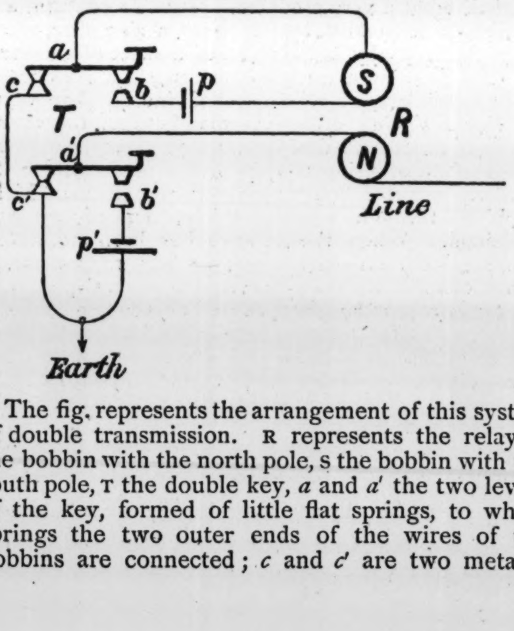
Lord Rosse also commenced experiments with a view to determining the value of selenium for purposes of photometric observations, but these were not very encouraging. "The results showed that the decrease in resistance varied far more in proportion to the square root of the intensity of the incident light than to the intensity simply, although no exact law has been obtained."

We think enough has been advanced to show that, not only is selenium a most interesting substance considered electrically, but that a close scrutiny of its behaviour under varied conditions may yet lead to the elucidation of important facts in physical science. Indeed, the lessons already taught by selenium seem to be a fitting accompaniment of those brought before us by Mr. Crooke's researches in radiometry.

DESCRIPTION OF A SYSTEM OF SIMULTANEOUS TRANSMISSION IN OPPOSITE DIRECTIONS.

By M. GIOVANNI MARINI,
Of the Italian Telegraphic Administration.

The system of double transmission that I am about to describe is based upon the following principles:—A relay with two bobbins is fixed to a permanent magnet in such a way that the armature acts by repulsion, and not by attraction. The wire of one of the bobbins is distinct from the wire of the other bobbin, and the two wires thus form two distinct circuits—the one a local circuit, the other a line circuit. The soft iron cores of these two bobbins of the relay are fixed, the one to the north pole, and the other to the south pole of a permanent magnet. The transmitting key is of the ordinary Morse form very slightly modified; to the front part of it two contacts insulated from one another are added, which serve for the two circuits above mentioned. These contacts should be so adjusted that by the movement of the key they should make or break contact exactly at the same moment.



The fig. represents the arrangement of this system of double transmission. R represents the relay, N the bobbin with the north pole, S the bobbin with the south pole, T the double key, *a* and *a'* the two levers of the key, formed of little flat springs, to which springs the two outer ends of the wires of the bobbins are connected; *c* and *c'* are two metallic contacts fixed at the extremities of the levers and in connection with the earth. In the normal position of this double key the levers rest on these contacts, and are thus in connection with the earth; *b* and *b'* are two little metallic plates connected to the positive poles of two batteries—the local battery *p*, and the line battery *p'*. The connections being thus arranged, the following results are obtained:—

It is first of all necessary that the strength of the local battery, which sends a current through the south pole bobbin, be so regulated that it may transmit a current exactly equal in power to the one sent out by the line battery through the wire of the other bobbin and out to line to the corresponding instrument at the further station. This equality can be arrived at by observing the deviations given by a good galvanometer, which can be switched either into the line or the local circuit—the battery of the latter being varied, so that the deflections in both cases are the same. When the batteries are in good condition this equilibrium may be maintained for several days unless accidental circumstances interfere.

For a line of a given resistance the relation between the local and line batteries is in the proportion of about 1 to 8. If, now, the key at one station be depressed, the levers *a a'* are put simultaneously in communication with the contacts *b b'*, and at the same instant the communication of the levers *c c'* with the earth is interrupted. The current of the local battery *p* traverses the south pole bobbins to get to earth, and produces in the soft iron core a contrary magnetism to that which is given it by the permanent magnet; that is to say, the current tends to diminish the attractive force of the core for the armature; but, at the same time, the current of the line battery *p'* traverses the north pole bobbin, and out to line, and increases the attractive power of the core of that bobbin; for at the transmitting station this current produces in the soft iron core a magnetism equal to that which the local battery takes away, consequently the armature remains attracted against the poles.

At the other station, the arrival current entering by the outer extremity of the wire of the north pole bobbin, goes to earth through the lever *a'* and the contact *c'*, and produces in the soft iron core a magnetism contrary to that which is given it by the permanent magnet; the attractive force on the armature being thus diminished, the armature rises off the poles under the influence of an antagonistic spring. Immediately on the cessation of the current the core regains its magnetism, and the armature is again attracted.

Finally, if the keys at both stations are simultaneously depressed, the currents going out to line being equal and contrary, annul one another, and thus the north pole bobbins of the two relays are not influenced by the currents. The south pole cores, then, being both under the influence of the local batteries, have their magnetic powers diminished, and the armatures at both stations consequently rise.

If in this last position one station allows his key to rise, the current from that station ceases to be emitted by him; but the connection of the line wire to earth is not interrupted, and the armature, though no longer under the influence of the local current, but under the influence of the current from the other station, which current is no longer nullified, continues to remain detached from the poles of the magnet. But at the moment when there are no longer simultaneous currents on the line, the battery of the station which continues to keep his key depressed, itself ceases to influence its own electro-magnet, and the armature at that station consequently rises.

Thus then the armature acts when the current arrives on the relay, or when the local battery is in action; but in these two cases, in order to detach the armature of the electro-magnet, it is sufficient simply to adjust it so that the strength of the arrival current is sufficient to diminish a little the magnetism imparted by the permanent magnet, and the armature then detaches itself from the cores by the influence of the antagonistic spring, and never by the action of the arrival current or the local current.

When, on the contrary, the armature is attracted, this attraction always takes place in virtue of the same constant force of the magnet, which at the moment when the arrival current ceases in the relay, or on the line, restores magnetic power to the cores as much when the key of the station, by which they are acted on, is in its normal condition as when it is depressed. Under this condition the armature is always attracted by a permanent magnetic force of equal strength, without undergoing in its movements any kind of change which could prevent the correct reception of the signals. In the laboratory experiments, this result can be obtained by the same form of key and with the same connections, with an ordinary relay, or Morse ink-writer of sufficient resistance, provided the two bobbins are separate, so that the connections can be made in the manner which has been indicated.

But such is not the case on a line, where, the armature of an ordinary relay being attracted irrespectively by the arrival and the local current, which are never equal (that of arrival being from the leakage on the line always less than the local current, which, as we have before said, is equal in strength to the departure current), would thus be affected either by the greater or by the less force, being thus able to remain continuously attracted if the spring is adjusted for the smaller current, or not being attracted at all if adjusted for the greater current.

In all these cases the movements of the armature would be very irregular, whence would result confused, broken, or weak signals.

It is for this reason that I have proposed for this system of transmission a relay with a polarised electro-magnet.—*Journal Telegraphique.*

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

At a meeting of this Society, held at the Institute of Civil Engineers, on Wednesday evening last, a paper was read by Mr. Willoughby Smith on "The Electrical qualities of Selenium, and the effect of Light thereon." But little or nothing new was advanced, the paper being chiefly devoted to statistics and details of experiments, the general character of which had been previously published. A few points may, however, be quoted—

Mr. Smith had found that in the preparation of selenium for resistances, great care must be observed in annealing it; if insufficiently or too highly heated the bars are rendered unfit for electrical purposes, being either too high or too low in resistance, or not constant. A properly annealed bar behaved like a dielectric, its resistance falling with increase of temperature.

The variation of resistance of selenium bars had been observed during an eclipse of the moon, and also during the passage of clouds across the sun; the general results of these experiments is already well known.

Mr. Smith incidentally mentioned that a platinum-silver wire resistance of one megohm costs about £80, while selenium resistances of from 1 to 500 megohms could be made for 30s. each.

For resistances of only one megohm or less, Mr. Smith would not advise the use of single bars of low resistance, but several bars of high resistance joined up in parallel circuit.

A short discussion followed the reading of the paper, in which Professor Abel, Professor Adams, Mr. W. H. Preece, Dr. Obach and others, took part. The experiences related by these gentlemen being of a somewhat conflicting nature, and showing that there is much to be done yet in reducing the facts about the behaviour of selenium to anything like harmony or certainty.

A short paper was also read by Mr. W. H. Preece, on "The Measurement of Currents," in which the author strongly advocated the more general adoption of the units recommended by the Standards Committee of the British Association. Mr. Preece further suggested the introduction of the milli-weber as a convenient sub-multiple of the weber in the estimation of current strength.

The electro-motive force in volts, and the resistance in ohms being known, $\frac{\text{E}}{\text{R}}$ gives the current in milli-webers.

PHYSICAL SOCIETY—17th November, 1877.

Dr. Stone, Vice-President, in the chair.

The President, Prof. G. C. Foster, described and exhibited a very simple form of absolute electrometer, which acts on the same principle as Sir W. Thomson's trap-door electrometer form of apparatus, but can be constructed at a very moderate cost. To one arm of a balance is suspended, by silk fibres, a zinc disc, which hangs horizontally in the plane of a sheet of the same material, forming a guard-plate; and at a distance of about 1 inch below is a flat sheet of zinc, also horizontal. An electrical connection is formed between the guard-plate and suspended disc by a bridge of very fine wire. The method of using the apparatus to determine the potential required for a spark to pass from a Holtz machine through varying thicknesses of air was explained. When the balance has been accurately counterpoised, an excess weight, say 1 gramme, is introduced into the scale-pan, and the guard-plate and the lower attracting plate, as well as the two knobs of a spark measurer, are connected with the conductors of the machine. If this be now set in action, and the knobs of the spark-measurer be gradually separated, a point will be reached at which the attraction upon the suspended disc just overcomes the excess weight in the balance-pan. The length of spark for which this occurs can now be read off. The difference of potential causing the spark is given by the formula $\frac{e}{a}\sqrt{8\text{F}}$, where a is the radius of the attracted disc, e its distance from the attracting plate, and F the force of attraction in degrees.

In the apparatus exhibited, a had the value, 5·195 c.m. and e the value 2·4 c.m., whence if w be the excess weight in grammes, so that $F = 981\,w$, the difference of potential becomes $39\sqrt{w}$. The proper action of the apparatus depends essentially upon the attracted disc being accurately in the same plane with the guard-plate. To facilitate this adjustment, each of the silk fibres by which the disc is suspended, is attached to a screw, by which it can be separately raised or lowered; and by means of another screw, a small brass plate, holding the suspending screws, can be raised or lowered as a whole. A few numerical results were given to illustrate the action of the apparatus. These were taken from a set of experiments in which the difference of potential needed to produce sparks in air between two equal brass spheres of 2·61 c.m. radius was measured. The following are the results for a few of the shortest and longest sparks measured:—

Length of Spark.	Difference of Potential.	Mean Electrical Force.
0·1525 c.m.	17·4	131
0·1825	20·4	117
0·237	24·6	104
"	"	"
"	"	"
"	"	"
"	"	"
0·68	62·9	93
0·71	65·2	92
0·74	68·7	93

METEOROLOGICAL SOCIETY.

THE first meeting of this Society for the present Session was held on Wednesday the 21st ulto., at the Institution of Civil Engineers; Mr. H. S. Eaton, M.A., President, in the chair. The following gentlemen were elected Fellows of the Society, viz.:—E. D. Archibald, B.A., R. W. P. Birch, Captain W. F. Caborne, H. Clarke, L.R.C.P., Cohen de Lessa, F.S.S., R. Gordon, J. Hunter, jun., J. J. Lake, Rev. E. A. D. O'Gara, O.S.B., R. Pennington, B.A., LL.B., E. E. Prichard, and Rev. S. J. W. Sanders, M.A.

The following papers were read:—

"On the general character and principal sources of variation in the weather at any part of a cyclone or anticyclone," by the Hon. Ralph Abercromby, F.M.S. In a cyclone, the broadest feature of the weather, as seen on a synoptic chart, is an area of rain about the centre, surrounded by a ring of clouds, beyond which the sky is clear. The precise form and position of these areas vary with the type of pressure distribution, with the intensity of the cyclone, and with the rate of its progress; they are also influenced by local diurnal and seasonal variations, the general sphere of each of which is indicated. By recording the appearance to a single observer of any part of a cyclone, as it passes over him, it is discovered that the area of rain and cloud-ring may be divided into two portions—the front and the rear—differing in physical appearance and general character of the weather by a line drawn through the centre, in front of which the barometer is falling, and in rear of which it is rising. Details are given, and it is shown that this character remains constant, whatever changes the variations above mentioned may effect. In anticyclones, synoptic charts show great irregularity in the positions of clouds, &c., owing to local, diurnal, and other variations; but to a single observer, who considers the surroundings and physical appearance, a certain general character can be discovered in every part. A marked contrast is shown to exist between the diurnal variation of the weather in a cyclone or anticyclone, and a probable connection is pointed out between the diurnal variation of the weather and the diurnal variation of the barometer.

"On a Remarkable Barometric Observation on January 30th, 1876," by Robert H. Scott, F.R.S. At 8 a.m. a remarkable dip appeared in the barometric curve for Armagh. The total amount of reduction of pressure was ·097 inch in 25, and for a portion of the time, from 8.5 to 8.10, the fall was ·058 inch, being at the rate of ·697 inch per hour. On looking to the other barograms, it was found that while a very similar oscillation of slightly greater amplitude, ·102 inch, appeared at Aberdeen at noon, almost exactly four hours subsequent to the occurrence at Armagh, hardly a trace of disturbance could be detected in the barogram for Glasgow, and yet the last named observatory lies almost on the direct line between Armagh and Aberdeen. The barograms for Stonyhurst and Halifax showed as little disturbance as Glasgow. At Dunech Observatory the oscillation took place somewhat earlier, and exhibited less intensity than at Aberdeen. At Bidston, however, which lies more out of the probable path of the depression than Stonyhurst, the oscillation is seemingly recorded with considerable distinctness. Temperature showed no appreciable change at Armagh, Glasgow, or Aberdeen. At the time of occurrence of the minimum, a temporary change of direction and increase of velocity of the wind, is recorded both at Armagh and Aberdeen.

"The 'Arched Squalls' of the neighbourhood of the Trade Winds, and of those regions where the Monsoons blow with slight force and with interruptions," by Captain A. Schück.

General Science Columns.

[By adding these columns on "General Science" to the TELEGRAPHIC JOURNAL, we hope to increase its usefulness. Some of the discoveries and inventions we shall have to chronicle will be found to have a more or less direct bearing on telegraphy, and others, although wholly unconnected with it, will perhaps be none the less interesting, especially to our numerous subscribers abroad whose other sources for such information may be scanty. The columns will contain the leading scientific advances which take place as time goes on. Gentlemen willing to contribute original articles to them are requested to communicate by letter with the "Manager," TELEGRAPHIC JOURNAL, 10, Paternoster Row, E.C.]

PROFESSOR PIAZZI SMYTH is of opinion that the coming winter will be a severe one. From observations of earth thermometers during a period of thirty nine years, he finds that between 1837 and 1876, three great heat waves passed over Great Britain; the first in 1846·5, the second in 1858·0, the third in 1868·7. The next will probably come in 1879·5, or within limits of six months either way. The periods of greatest cold are not midway between these crests of greatest heat, but are comparatively close up to them on either side, at an interval of about a year and a half. Consequently the next cold wave is to be looked for at the end of the present year.

AT Cape May, in America, there is an extensive marsh full of the trunks of fallen white cedars, which are being hauled forth and cut up into timber at a great profit. These trees have been in past times levelled by hurricanes and swallowed up in the mud of the marsh, whose antiseptic properties has preserved them fresh till now. At certain places there are as many as three successive layers of trunks one above another in these "cedar mines," and a live forest growing over all. The age of some of the trees is reckoned over 1000 years, and a single trunk has yielded 10,000 shingles worth £4 the hundred.

LIVINGSTONE'S companion, the Rev. Horace Waller, recently presented to the Royal Botanic Society a specimen of the curious "Ambatch" wood of Africa. The natives of the Lake districts build their canoes of this wood, which is remarkably light. It is said that forests of ambatch float about on the lakes, and sometimes block up or conceal the mouths of the rivers opening on the lake, so that the tree, which is of very rapid growth, in a short time alters the geographical features of the district.

THE researches of Cameron and Stanley have evidently given rise to increased activity in African exploration. A new French expedition is announced to start up the west bank of the Niger, in order to cross the unknown regions of equatorial Africa to the Indian Ocean. It will be in command of Count de Semellé, a lieutenant of the French army, who has passed almost all his life in Algeria, and will be accompanied by a strong escort of old Algerian soldiers.

An Italian expedition has also started from Cairo up the Nile *via* Khartoom, and an English expedition has left Suez for Souakim under the Hon. Guy C. Dawnay, son of Viscount Downe.

PLASTER CASTS THAT CAN BE WASHED.—The prize offered by the Prussian Minister of Commerce and Industry for a method of preparing plaster casts so as to permit of their being washed, has been awarded to Dr. W. Reissig, of Darmstadt. The object was to obtain a surface which should not dissolve in water, and should prevent dust from entering the pores. Dr. Reissig's process consists in converting the sulphate of lime (1) into sulphate of baryta, and caustic or carbonate of lime, and (2) into silicate of lime, by means of silicate of potash. Objects treated in this way are unaffected by hot water or soap, but are still porous and capable of retaining dust, so, in order to render them non-porous, it is necessary to coat them with an alcoholic soap solution, which, on being evaporated, leaves a layer of the soap filling up the pores.

A PRIZE of £5,000 is offered by the Government of India to the inventor of the best machine or process for preparing the fibre of the Ramie, or China grass. This fibre is the inner bark of the Ramie plant, and "Japan silk," "Nankin linen," and "grass cloth," are made from it. It is stronger and more elastic than flax, hemp, or cotton, being only inferior to silk, and its lustrous whiteness adds to its value. Trials of the machine will take place at Sahâranpur in August, 1879. The inventor of the second best machine will receive £1,000.

PRACTICAL EVOLUTION.—A German lady, Fraulein Marie von Chauvin, has recently succeeded in changing two water breathing Mexican axolotls into air breathing land salamanders, a change comparable with the development of the tadpole into the frog. Madame Chauvin gradually accustomed the axolotls to being kept in the air, packed in a bed of wet moss, and fed them on worms. After a few days the gill tufts and tail fin decreased in size, and ultimately were discarded altogether being partly shrivelled up, and perhaps partly absorbed. The skin was repeatedly cast, the eyes became larger, and the skin changed its colour from black to violet and black with yellow spots. Ere long, on being put into the water, the salamanders struggled back to land, and became true land dwellers. The same process has been observed before. In 1867 Dumèril, a French naturalist, observed that out of many hundred axolotls kept at the Jardin des Plantes, in Paris, thirty lost their gills and became air breathers and land dwellers. In 1868, also, Professors Marsh and Eustis, in America, following up the observations of Dumèril, brought some axolotls from Lake Como, in the mountains of Wyoming territory, and several of them changed into land salamanders, the others remaining in their original condition. In those that developed, a succession of warm days hastened the transformation, whereas a series of cooler days arrested it. No transformations have ever been observed at Lake Como itself; but a resident at Cheyenne has a stock of salamanders which have changed in his keeping from the axolotl state. Professor Marsh thinks that the cold nights of the elevated regions of the lake check the natural course of development, and it is probable that the axolotls of the Lake of Mexico and other Rocky Mountain lakes, are *amblystoma*, or land salamanders, whose development has been arrested by climatic changes, at a period so recent that they have not entirely lost their capacity for becoming fully developed under favourable conditions.

DURING a recent geological exploring expedition to the bed of the ancient Cretaceous sea in the Colorado region of the Rocky Mountains, Professor O. C. Marsh discovered the fossil remains of many large dinosaurians, one being sixty-one feet in length, and perhaps the largest animal that ever existed. These saurians walked on their hind feet, and when erect must have been at least thirty feet high. Their bones are hollow like those of a bird, so as to combine both strength and lightness. They reached a great pitch of development during the Cretaceous period in America. Professor Marsh found in one valley in Colorado no less than seven gigantic skeletons in the field of view at one time. Remains of enormous flying lizards, pterosauria, ten to twenty-five feet across the wings, have also been found, and crocodiles, which prove to be a missing link between those of the past and present. The well-known "bird tracks" in the sandstones of the Connecticut valley, are attributed by Professor Marsh to three-toed saurian reptiles, which walked usually on their hind legs. Professor Marsh also reports the discovery of two species of fossil bisons, in the lower pliocene of Kansas and Nebraska. They are larger than the existing species, and have bigger horns.

Captain Weyprecht, of the Austro-Hungarian Polar expedition, has prepared a programme of scientific duties to be undertaken by the proposed international Polar expeditions. It will be submitted to the International Meteorological Congress which is to meet next year. The International Polar expeditions will have for aim to establish meteorological stations at different points within or near the Arctic and Antarctic regions, in order to make meteorological, physiographical, and magnetic observations, and it is argued that such united and synchronous action on the part of a number of observers at different stations is far more valuable than single expeditions at different times.

The Compass Plant.—The *silphium laciniatum*, or "rosin-weed," or "compass plant," of the American prairies, is well-known as possessing the peculiar property of turning its leaves in a north and south direction, and has therefore become a guide to travellers on the plains. Mr. Bessey, an American, has made experiments recently to test the truth of the alleged polarity of its leaves. Out of ninety-three plants observed, forty-one were found to have their leaves pointing at various angles within 25 deg. east of north, and twenty-four were found to point variously within 25 deg. west of north. The remainder pointed either east or west of north to a greater degree; but the polarity of the leaves was sufficiently proven.

Sun's Distance.—The Astronomer-Royal's first Report on the telescopic observations of the transit of Venus in 1874, made by the British expeditions, places the sun's mean distance at 93,321,000 miles. This result has still to be checked by the figures deduced from measurements of the photographic observations.

Explosions in Mines.—Mr. W. Galloway, who has made a special study of this subject, lays down the conditions by which an escape of inflammable gas in a mine is liable to cause an explosion, as follows:—"An explosion will happen—firstly, if the inflammable gas passes over a furnace at the bottom of the upcast; secondly, if it is carried against a Davy or Clanny lamp at a greater velocity than seven feet per second, or if the lamp is traversed by a sound wave; thirdly, if a blasting shot is fired directly into it; and lastly, if it reaches a safety lamp that has been opened by one of the men." The means that have been provided for guarding against explosions are—(1), that furnaces have been to a large extent replaced by ventilating fans in fiery collieries; (2), Davy and Clanny lamps are still almost universally employed, "and little importance seems to be attached to their known imperfections by those who are supposed to be capable of deciding the question;" (3), shot-firing is now carried on under certain restrictions, which, however, Mr. Galloway thinks are still insufficient. The fact that firedamp, and consequently explosions, are more prevalent during times of low barometer has been asserted for the last fifty or sixty years. Mr. R. H. Scott and Mr. Galloway have clearly shown by diagrams and statistics the convincing connection between the two phenomena, and in the Coal Mines Regulation Act of 1872, a clause was inserted compelling mine-owners to place a barometer and thermometer at the entrance to every coal mine. We may mention here that the late Leverrier wished to telegraph useful meteorological observations to fiery mines.

It is difficult for mining men to account for great explosions, like that at Blantyre lately, when it is known that immediately beforehand little or no inflammable gas was present in the workings. They have generally been attributed to sudden outbursts of a great volume of pent up gas; but according to Mr. Galloway these sudden outbursts are entirely unknown in some localities where great explosions have happened. He is of opinion that the real cause is to be sought in the fine dry coal dust which pervades the air of the workings. In 1844 Messrs. Lyell and Faraday reported to the Home Secretary on the Haswell explosion, and found that the coal dust was the fuel of the explosion, as well as the fire-damp. M. Vital, Engineer of Mines in France, showed that a flame is greatly lengthened in an atmosphere containing a cloud of coal dust; and Mr. Galloway has ascertained that air containing a small proportion of fire-damp (less than 1 per cent. by volume) becomes highly inflammable when coal dust is mixed with it. "These discoveries complete what Lyell and Faraday began, and show how explosions of any conceivable magnitude may occur in mines containing dry coal-dust. A blasting shot, or a small local explosion of fire-damp, or a naked light exposed when a cloud of coal dust is raised up by a fall of roof in air already containing a little fire-damp, is sufficient to irritate them, and when once they are begun, they become self-sustaining."—We quote from *Nature*, Nov. 8.

Photography.—Perhaps in no other branch of industry has greater progress been made in a shorter period of time than in the study, elaboration and application of the art-science photography. Lending itself as an adjunct to almost every variety of scientific and pleasurable pursuit, the camera has become an indispensable instrument to the astronomer, the engineer, the military officer, the artist, sportsman, and tourist. Its votaries have given free play to their inventive powers and fancy in designing every description of apparatus, until it would seem to the uninitiated that variety and adaptibility could go no further. To the real student-photographer, however, there yet remains an endless field of research in the improvement of the chemical means at his disposal.

Messrs. Wratten and Wainwright,* have introduced a new system of photography, specially adapted to the wants of those who seek to make the camera the companion of their travels. Such a process ought to possess all the merits of the photographer's *wet* plate, rapidity and certainty, without its demerits, cumbrous paraphernalia, fog, stains, &c. It should be suitable for portraits, groups and landscapes, and should give first-rate results in the minimum space of time available for any kind of subject.

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* No. 38, Great Queen Street, Long Acre.

Any one who has worked the wet process will have a vivid remembrance of the trouble, fog, stains, and soiled fingers it entailed; and how often the sheet anchor of the process, the negative silver bath, was found to be out of order at the very nick of time. By the new plan, no silver bath is needed. The silver nitrate has already been united to the haloid salts in the collodion; double decomposition, or, in other words, interchange of elements has resulted, the useless product of decomposition has been eliminated, and a bottle of sensitive material technically termed a "Washed Emulsion" is the result.

In the preparation of sensitive plates it is only necessary to shake the bottle of emulsion thoroughly, let it stand ten minutes, then pour it (as one does collodion in the wet process) over the glass plate. The glass must of course have been perfectly cleaned, and this is best done with a mixture of tripoli in alcohol as a first course, followed by French chalk, which gives a greasy surface, on which, strange as it may seem, the film mechanically takes hold with great tenacity. So soon as the film has "set" (in about two minutes), the plate, if required for immediate use, may be placed in the dark slide and exposed, or if not required until next day, may be dried in two minutes over a small hot-water tin. It dries spontaneously in about twenty minutes. These operations must be performed under the influence of non-actinic light. A small portable lantern fitted with ruby glass answers well, when, as in travelling, operations are carried on in an ordinary room, from which white light has, of course, been excluded.

After exposure, the film is washed and the picture promptly developed to printing density with a mixture of pyrogallic acid and ammonia, restrained in action by a suitable quantity of potassium bromide. It is then washed and fixed, and washed again. The film can then be removed to a piece of prepared paper, and when dry, stored in a book until the traveller's return home, when, with great ease, it may be again superimposed on glass for printing.

This method of removing each day's negatives from the glass to paper presents two advantages: firstly, the negatives can be safely carried, and in a light bulk; and, secondly, six pieces of glass will serve for the production of an indefinite number of negatives. A novice can, we are assured, in one week make himself fairly efficient in the working of this process, and hence it is likely to prove of great service to sightseers and travellers of all kinds.

PROFESSOR TOBIN of the Central University, Richmond, Kentucky, has invented a delicate and convenient apparatus for exhibiting Foucault's celebrated pendulum experiment. The instrument is about six feet high, and consists of a tripod, and a pendulum having an index attached to its upper end. When the pendulum is started into vibration, the index is at zero on a scale, but after about six minutes the index is found to have deviated about one degree. An hour is sufficient time to enable the earth's motion in space to be calculated from the deflection of the index. The pendulum is so delicately constructed that it will remain in motion twelve hours after being set going.

REVOLVING TAIL-LIGHTS FOR RAILWAY TRAINS.—An old proposal has been adopted on the Pennsylvania railroad for tail-lights. It is simply a flashing light produced by a revolving lamp worked by gearing in connection with the axle. It will be understood that when the train is standing still, the light shines steadily in either red or white, but when the train is in motion the light rapidly changes from red to white, and from white to red.—*Western* (*American*) *Review*.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—Having noticed a misprint of the formula (Clark and Sabine, page 29), referred to in my paper on "A New Formula for Calculating the Copper Resistance during Earth-Currents," published in your last issue, I beg you to make a small correction and alteration of the *last part* of my paper, which should read as follows:

"In cases of heavy earth-currents, when the direct arithmetical mean $\left(x = \frac{r + \text{R}}{2}\right)$ is simply useless, and, according to my experience, the results obtained by the *reciprocal mean*, or Mr. Schwendler's formula (Clark and Sabine, page 29), is *too low*, the new formula ($x = \sqrt{r.\text{R}}$) gives the true, or about the true, value."

It is clear that the expression ($x = \sqrt{r.\text{R}}$) holds good also in cases of *testing for faults*, when there is a great difference between the readings with the zinc and the copper-pole.

When dealing with lines in a disturbed state, I always calculate the mean of my zinc and copper readings by this simple formula, and find it to answer admirably.—I am, Sir, yours faithfully,

CH. DRESING, A.S.T.E.

Great Northern Telegraph Company,
Aberdeen, Nov. 21, 1877.

[We have tried Mr. Dresing's formula, and found it to give very accurate results. At the same time, however, we are unable to understand how Mr. Schwendler's formula can give a too low result; it is an *exact* formula, and if properly worked out, *must* give the exact value of x.—EDIT. TELEGRAPHIC JOURNAL.]

TELEGRAPHIST.—M. Hippolyte Fontaine's work on Lighting by Electricity (Eclairage à l' Electricité) is published in one vol., price 6 francs, by A. Buquet, at the Bureau de la Revue Industrielle, 52, Rue Saint Georges, Paris.

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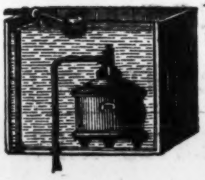

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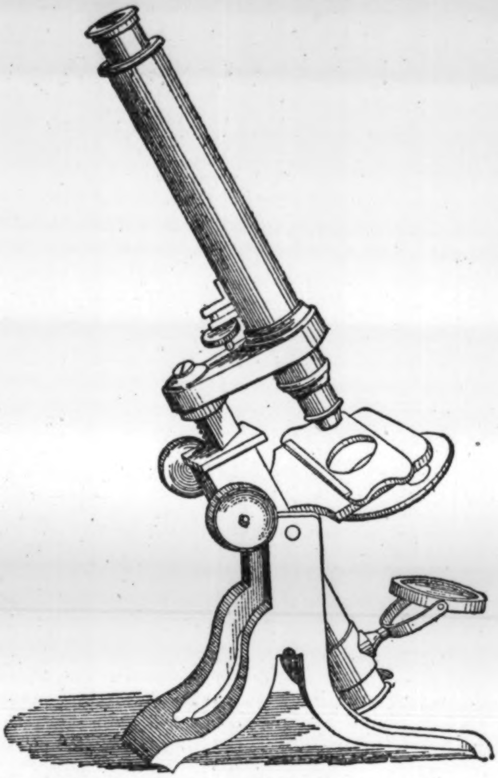

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